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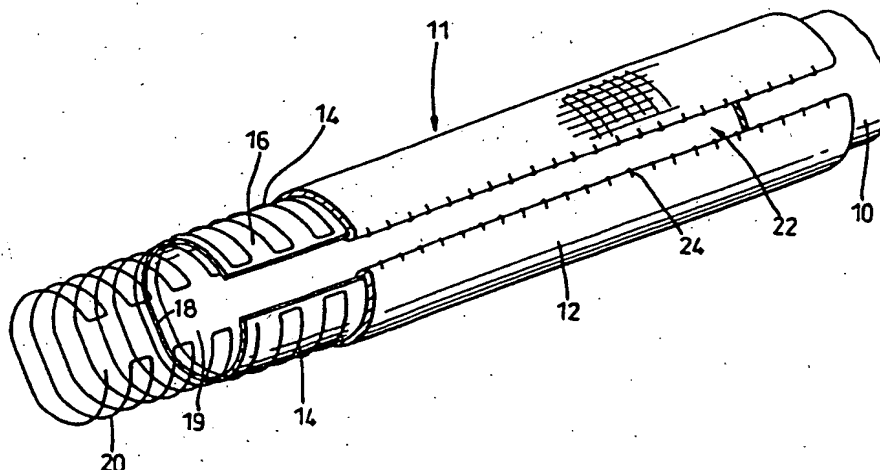
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(54) Title: WRAPPABLE SLEEVE



## (57) Abstract

A split sleeve (11) for insulation of heat generating components, such as an exhaust gas recirculation device, comprises an outer layer of knitted woven or braided glass fibre yarn (12). A first metal wire (14) skeleton or frame in the form of a continuous wire support for the outer layer (12) is bent in a first step with a series of reverse bends to form a comb-like structure and in a second step to a C-shaped cross-sectional configuration in which the wire defines a cavity and the wire bends define an opening (22) extending lengthwise of the cavity. A layer of heat insulating mineral paper (16) is spaced from the cover layer (12) by the metal wire (14) skeleton. The heat wire layer (20) configured like the first extends lengthwise of the sleeve (11) and spaces the reflective surface (19) of the foil (18) from the heat generating component. The various layers of the sleeve are secured together to form an axially extending opening which fits over the component requiring insulation.

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### Wrappable Sleeve

This invention relates to multi-layered sleeving products having heat insulating and reflecting layers and more particularly to sleeving products for thermally insulating a high temperature device, such as an automotive exhaust gas recirculation tube.

### Background of the Invention

Various efforts have been made to provide relatively low cost light-weight insulating sleeving for the purposes of thermally insulating high-heat generating components, such as exhaust gas recirculation tubes. In a modern automobile, the latest versions of these devices operate with inlet gas temperatures ranging from above about 1000°F to about 1800°F. The devices generate undesirable heat which may discomfort the occupants within the passenger compartment and may damage nearby mechanical components and floor covering materials and have been known to cause fire if the vehicle is left idling when parked over dry grass.

A problem exists in dealing with these temperatures in that presently available insulating materials do not tolerate very well the high temperatures likely to be encountered. At best, they tend to degrade relatively rapidly. At the high end of the temperature range mentioned above, materials such as glass fibre insulating materials will melt. At present, no reasonably priced, low cost alternative has been found to be entirely satisfactory for this application.

Although sleeveings having means providing an air space between the heat source and the insulating materials have been effectively utilised for many applications, an as yet unsatisfied need persists for a cost effective insulation sleeve having high durability for high temperature devices for use in modern high performance vehicles.

### Summary and Objects of the Invention

According to the invention, an insulating sleeve product is provided which is split lengthwise to fit over a heat generating component. The sleeve and yieldable product comprises an inner, first tubular spacer layer of a metal wire pre-bent to a C-shaped or clam shell cross-section, which layer is generally conformable to the outer surface of the heat generating component. The first tubular spacer layer of the invention supports an insulating layer of rockwool or like insulating material to which a metal foil is attached. The foil has a reflective face which is spaced from the heat generating component by the metal wire layer. A second layer of metal wire configured like the first is disposed to fit against the opposite surface of the layer of insulating material and spaces that layer from an outer layer of interlaced insulating yarn.

More particularly, the relatively fragile foil layer is preferably laminated to the mineral wool paper layer prior to construction of the sleeve. Since the need for adhesion between the paper and the foil exists only during assembly, inexpensive adhesives which may burn off during use are suitable for the purpose. Once the sleeving product is placed in use, the outer layers of wire and insulating yarn serve as the primary means to maintain the inner layers in place.

With the foregoing in view, a primary objective of the invention is the provision of high performance, durable, low cost heat insulating sleeving of lightweight construction useful for the insulation of high temperature exhaust gas recirculation products.

Further objects of the invention include the provision of heat insulating sleeveings which are easy to install over previously installed devices, elimination of the need for additional attachment means and the provision of a sleeve which accommodates breakouts.

How the foregoing and other objects of the invention are achieved will become apparent from the following detailed description of a preferred embodiment of the invention.

### Brief Description of the Drawings

Figure 1 is a perspective view of a split sleeve formed according to the invention with portions of the sleeve removed for illustrative purposes;

Figure 2 is an end view of the sleeve of Figure 1;

and

Figure 3 is a view of a preferred form of pre-bent support wire utilised in carrying out the objectives of the invention.

#### Detailed Description of the Preferred Embodiment of the Invention

With reference to Figure 1, an exhaust gas recirculation device, partially shown generally at 10, is covered with an insulating sleeve 11 made according to the invention.

Sleeve 11 preferably comprises an outer covering layer 12 formed of an insulating, heat resistant yarn, such as glass fibre, relatively tightly interlaced as by weaving, braiding or knitting. A preferred material for cover layer 12 is E-glass yarn provided as three ends of continuous filament yarn of 3608 denier each. The cover layer is preferably tightly woven and is impregnated with a high temperature coating material, such as epoxy/silicone resin, which eliminates end fray and provides resistance to abrading of the glass fibres.

Located internally of the cover is a first wire support layer 14 comprising a continuous wire form of the type sold by Renz America of Agwan, Massachusetts, and commonly used for the purpose of binding the pages of notebooks. This wire is first pre-bent into a so-called "comb configuration" by imparting to it spaced reverse bends and then formed into a C-shaped or clam shell cross-section in a separate processing step so that it defines an interior cavity with an opening formed along one side. A piece of pre-bent wire of preferred shape is illustrated in Figure 3. The wire form layer is readily flexible about its long axis and, while somewhat rigid, desirably should have sufficient ductility so as to stay in the shape to which it is crimped down when fitted over objects. The wire layer extends lengthwise of the sleeve, providing support to the cover layer and spacing for the next layer to be described subsequently. The wire of layer 14 is shown extending beyond the left-hand end of the cover layer 12 of tubular sleeve 11 in Figure 1.

Located internally of the wire form layer 14 is a second insulating layer 16 formed of a material having a high heat insulating value. Preferably, layer 16 is a mineral wool felted material in which the mineral material is rockwool, although other mineral materials, such

as glass fibre and ceramics in felted form, may be employed. In the illustrative embodiment, the felt has a thickness of about 2mm. A suitable mineral wool felted material is available from Tenmat of Manchester, England, in a paper or felt of 2mm thickness.

According to the invention, a foil layer 18 is bonded to the inner surface of insulating layer 16. The foil layer 18 preferably has a thickness of about .001 inches and has a reflective surface 19 directed inwardly towards the article. The foil layer may be adhesively secured to the layer by an adhesive which burns off in use.

A final layer 20 formed of metal wire, and preferably of a form similar to wire layer 14, is located internally of the tube and functions to maintain a spacing between the reflective foil surface and the device being insulated. In use for the insulation of exhaust gas recirculation devices, wire having a diameter of about 1mm is considered to be adequate.

As can be seen with reference to Figures 1 and 2, the layers are interpositioned to provide a side opening 22 to allow for fitting the sleeve over the device being covered. The edges of the outer cover layer 12 are folded around the insulating layer 16 and secured in place by such stitching 24, as seen in Figure 1, although other methods of securing the layers together may be employed. The stitching 24 extends through the loops of inner wire layer 20 so that the entire assembly is secured in place.

The ends of the finished product may be fitted with a C-shaped ferrule of metal, rubber or the like to eliminate any tendency to fray.

The pre-bent wire layers 14 and 20 are formed of a relatively ductile wire which allows for sufficient expansion of the sleeve to fit over the object being covered including irregularities, such as connector flanges. The wire desirably has sufficient resilience so that it acts to return the sleeve to a closed position in which it is clamped over the device and is retained in place without the need for clamps or straps. The sleeve so formed is readily bendable, allowing it to fit around curved pieces. The axial slit accommodates breakouts, such as pick-up tubes. A single sized tube accommodates exhaust gas recirculation devices of a range of diameters. The product is durable and has enhanced insulation capabilities which are imparted by the various insulation layers and the spacing wire layers. The sleeving is easily installed without the need for special tools.

CLAIMS

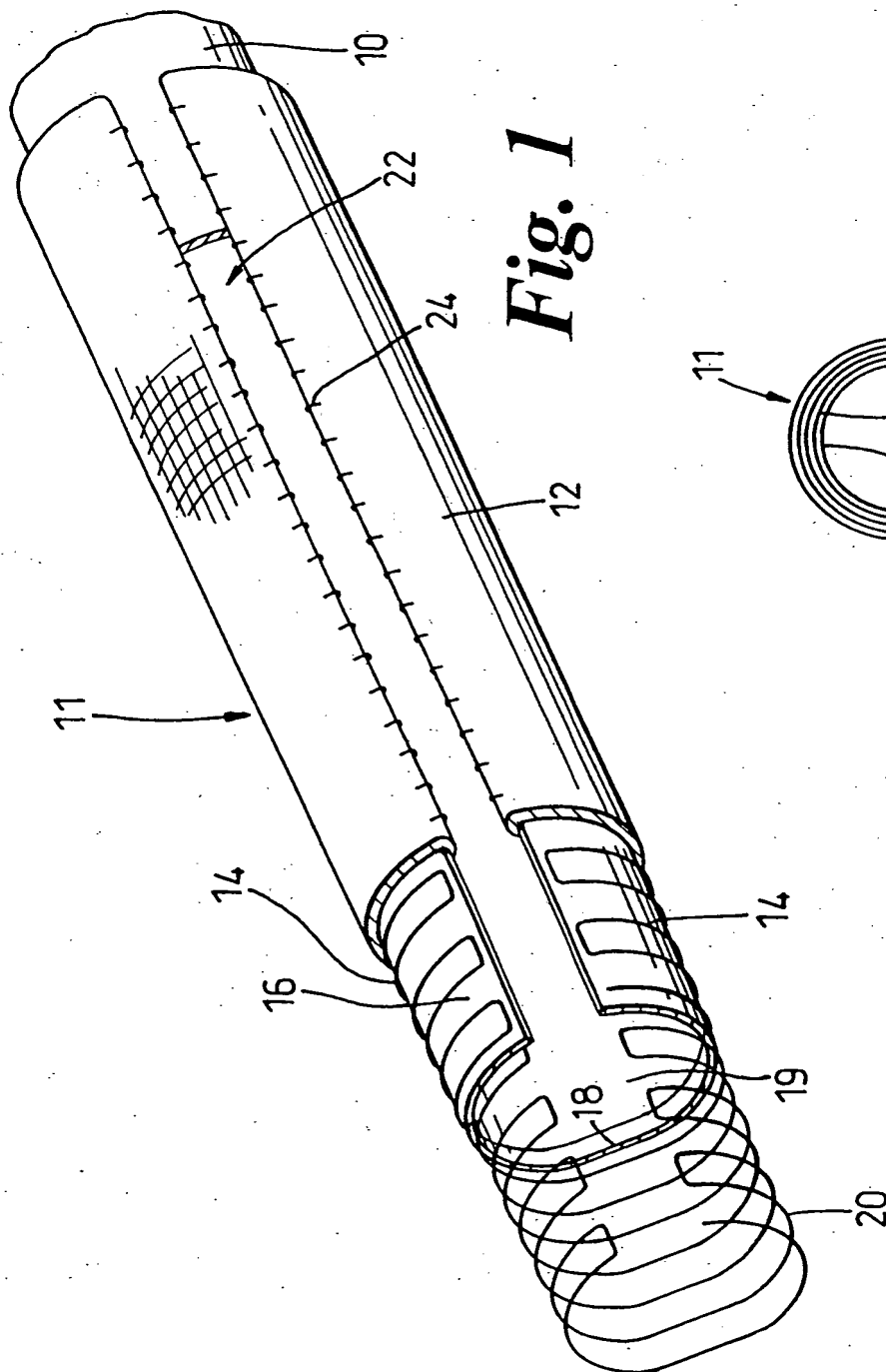
1. A split sleeve adapted to be placed in surrounding relationship with a heat generating component, said split sleeve comprising:-  
an outer cover layer of interlaced heat insulating yarn;  
a first metal wire layer comprising a continuous wire support bent in cross-section to a C-shaped configuration, said first metal wire layer defining a cavity having a side opening extending lengthwise of said sleeve and said continuous wire support being longitudinally flexible;  
an intermediate layer of a heat insulating material spaced from said outer cover layer by said continuous wire support;  
a metal foil layer adjacent to the intermediate layer on the side away from the first wire layer, said foil layer having a reflective surface exposed to said heat generating component; and  
a second metal wire layer extending lengthwise of the sleeve, said second wire layer having a configuration substantially the same as the first wire layer, said second wire layer interfacing with the surface of the foil away from the insulating layer, said second wire layer being adapted to space said reflective surface from the heat generating component, each of said layers having edge portions terminating at the boundaries of said side opening.
2. A split sleeve according to claim 1, wherein said heat insulating layer is a felt material.
3. A split sleeve according to claim 2, wherein said felt material is selected from the group comprising rockwool, glass.fibre and ceramics.
4. A split sleeve according to claim 3, wherein said foil layer is adhesively bonded to said layer of heat insulating material.
5. A split sleeve according to claim 1, wherein said second wire layer comprises a second continuous wire bent in cross-section to a C-shaped configuration, said second continuous wire extending lengthwise of the sleeve and being longitudinally flexible.
6. A split sleeve according to claim 5, wherein said heat insulating layer is a felt material.

7. A split sleeve according to claim 6, wherein said felt material is a rockwool paper.
8. A split sleeve according to claim 7, wherein said foil layer is adhesively bonded to said rockwool paper.
9. A split sleeve according to claim 8, wherein said cover layer is comprised of glass fibre yarn.
10. A split sleeve according to claim 9, wherein said glass fibre yarn is a woven E glass yarn.
11. A split sleeve according to claim 10, wherein said cover layer further comprises an epoxy/silicone coating.
12. A split sleeve for insulation of a heat generating component such as an automotive exhaust gas recirculation device, said sleeve comprising;
  - a first, outer layer comprised of woven glass fibre yarn;
  - a layer of relatively non-resilient, bendable metallic wire, said wire being bent to a generally C-shaped configuration extending lengthwise of the sleeve and being flexible about its long axis;
  - a layer of a heat insulating mineral paper spaced from said outer layer by said layer of bendable wire; and
  - a spacer layer for maintaining an air space between said layer of heat insulating mineral paper and said heat generating component.
13. A split sleeve according to claim 12, wherein said spacer layer comprises a second layer of wire.
14. A split sleeve according to claim 13, further comprising a metal foil layer adjacent to the layer of heat insulating mineral paper on the side away from the first layer of wire, said metal foil layer having a reflective surface exposed to said heat generating component.

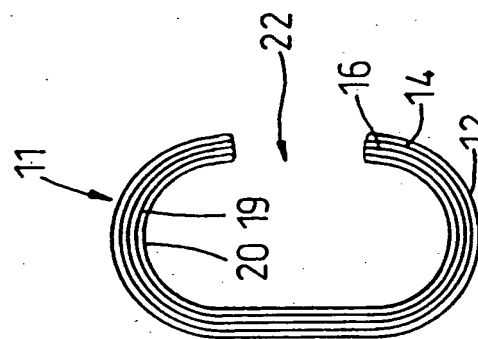


15. A split sleeve according to claim 14, wherein said second layer of wire comprises a relatively non-resilient, bendable metal wire bent in cross-section to a C-shaped configuration and being flexible about its long axis.
16. A split sleeve according to claim 15, wherein said woven glass fibre yarn is E glass.
17. A split sleeve according to claim 16, wherein said woven glass fibre yarn is coated with a layer of silicone material.
18. A split sleeve according to claim 16, wherein said metal foil layer is adhesively bonded to said layer of heat insulating mineral paper.
19. A split sleeve according to claim 17, wherein said layer of silicone material is an epoxy/silicone.

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**Fig. 1**



**Fig. 2**

2/2

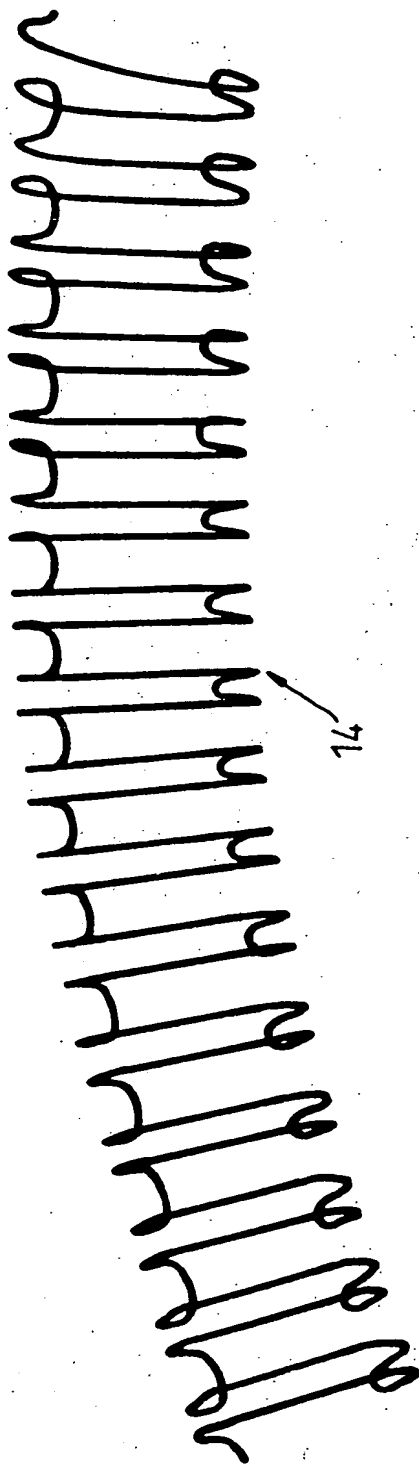


Fig. 3

# INTERNATIONAL SEARCH REPORT

International Application No

PCT/GB 97/03517

## A. CLASSIFICATION OF SUBJECT MATTER

IPC 6 F16L59/02 B60R13/08 F01N7/14

According to International Patent Classification (IPC) or to both national classification and IPC

## B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

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Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	DE 38 21 468 A (DIEDRICHS HELMUT W) 28 December 1989 see abstract; figure 5	1-19
A	EP 0 011 196 A (KARL KLEIN KUNSTSTOFF FABRIK F) 28 May 1980 see abstract; figure	1-19
A	CH 249 215 A (WILLI GEISSMANN) 1 April 1948 see claims; figures 1,2	1-19
A	EP 0 224 824 A (FIAT AUTO SPA) 10 June 1987 see abstract; figures 1,2	1,12

☐ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

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